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Invention: METHOD FOR IMPROVING THE PERFORMANCE OF USSD TRANSFER IN A CELLULAR COMMUNICATIONS SYSTEM

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SPECIFICATION

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METHOD FOR IMPROVING THE PERFORMANCE OF USSD TRANSFER IN A CELLULAR COMMUNICATIONS SYSTEM

BACKGROUND OF THE INVENTION

The invention relates to improving the performance of USSD (Unstructured Supplementary Service Data) transfer in a cellular communica-
5   tions system, such as GSM (Global System for Mobile Communication).

The user of a mobile station (MS) can use USSD to give instructions to the supporting PLMN (Public Land based Mobile Network). For example, incoming calls can be routed to number 123456 by dialling *21*#123456#. USSD is also one of the mechanisms for implementing new services. USSD
10   allows an MS and a service application to communicate with each other by character strings, in a way which is transparent to the MS and to the intermediate network elements. USSD can be used as a narrow-band bearer for over-the-air (OTA) and value-added services (VAS) applications. With respect to a more detailed description of the USSD, reference is made to the following
15   ETSI GSM recommendations: GSM 02.90: *European digital cellular telecommunications system (Phase 2); Stage 1 description of Unstructured Supplementary Service Data (USSD)*, GSM 03.90: *Digital cellular telecommunications system (Phase 2); Unstructured Supplementary Service Data (USSD) - Stage 2*, and GSM 04.90: *European digital cellular telecommunications system
20   (Phase 2); Unstructured Supplementary Service Data (USSD) - Stage 3*. USSD requests, notifications and responses contain a USSD string, an alphabet indicator and a language indicator, as defined in GSM 03.38.

USSD signalling may be initiated by the mobile station or by the network. Phase 1 supports only MS-initiated USSD. Network-initiated USSD
25   service requires that all parts of the mobile communications system be at least phase 2 systems. The mobile communications network may at any time send a USSD message to a mobile station MS registered with the network in order to transmit information to the subscriber. This operation may be either a request (asking the MS to provide information) or a notification (requiring no in-
30   formation to be provided by the MS). No prior provisioning of USSD is required, although provisioning of services which make use of USSD may be required.

According to the above ETSI recommendations, USSD signalling takes place between an MS and an MSC/VLR (Mobile services Switching
35   Centre/Visitor Location Register) or HLR (Home Location Register). USSD supports a maximum of 160 bytes of user data per message. (The upper limit

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can be less than 160 bytes depending on the underlying protocol layers.) Unlike SMS (Short Message Service), USSD has no store-and-forward functionality: mobile-terminated USSD messages are delivered to the MS immediately, or the delivery fails (e.g. because the MS is unreachable).

5   For the purposes of this application, a GSM-type mobile station has two modes: a call mode and an idle mode. A mobile station is in call mode if and only if it is "in a call", which state is defined in the GSM recommendation 02.30.

          According to the above ETSI recommendations, USSD transfer
10 takes place on two different channels depending on whether or not the MS is in call mode or idle mode. In call mode, Fast Associated Control Channel (FACCH) is used. In idle mode, Slow Dedicated Control Channel (SDCCH) is used.

          The speed of the FACCH channel is approximately 140 bytes per
15 second and that of the SDCCH channel approximately 83 bytes per second. Thus, even in idle mode, any USSD message can be delivered in less than two seconds.

          It is conceivable that the use of USSD for implementing value-added and over-the-air services will increase. In this case, especially if multiple
20 consecutive USSD messages are needed, the slow transfer speed of the SDCCH channel could be seen as a problem. (It should be noted that for keeping the description compact, FACCH is used as a synonym for the fast channel, and SDCCH is used as a synonym for the slow channel. However, FACCH and SDCCH are terms used in the GSM system and its derivatives,
25 but these terms are not necessarily used in future cellular systems.)

BRIEF SUMMARY OF THE INVENTION

          Accordingly, it is an object of the present invention to study whether the speed of USSD in idle mode can be improved, and if yes, to provide a method and equipment for improving the speed of USSD in idle mode. The
30 object is achieved with a method and equipment which are characterized by what is disclosed in the attached independent claims. Preferred embodiments are disclosed in the attached dependent claims.

          A straightforward way of improving the speed of USSD transfer would be to specify that all USSD traffic takes place on the fast FACCH chan-
35 nel. This would, however, require changes in existing standardisation. Also, FACCH is not a dedicated channel, but an associated one, which means that it

is implemented by stealing bits from the speech channel, if one exists. If such bit stealing is allowed to go on for long periods of time, it will degrade speech quality to some extent.

The invention is based on locating the problem and finding a solu-
5   tion for it. The solution is based on the idea that the amount of USSD data is determined, and if the amount exceeds (or is likely to exceed) a predetermined threshold (i.e. for lengthy USSD transmissions), the faster FACCH channel is activated by directing the MS into call mode. A simple way of accomplishing this is performing an unsuccessful call attempt.

10   Thus it can also be said that the invention is based on a novel inter-
pretation of call mode, as specified in the above-referenced GSM recommen-
dation 02.30, wherein call mode is defined as follows: *A mobile station is in a
call from the time that signalling related to the establishment or attempted es-
tablishment of a mobile originated or mobile terminated call commences, and*
15   *before the call or call attempt ends, and (if applicable), the mobile equipment
has stopped generating tones related to this call to the user.* Fooling the MS into call mode (by performing an unsuccessful call attempt) activates the faster FACCH channel for USSD transfer. However, it should be noted that the mo-
bile station is "in a call" as defined by ETSI GSM 02.30, whereby the invention
20   requires no deviations from existing standards. Thus the method and equip-
ment according to the invention solve the problem of the prior art USSD transfer in an elegant manner.

The invention is also based on determining the amount of USSD data (i.e. the length of USSD transmission) and using the FACCH channel
25   only for lengthy USSD transmissions. Performing an unsuccessful call attempt for short USSD transmissions would create unnecessary signalling load, which is especially harmful at the air interface. This signalling load must be balanced against the savings in time brought about by the mechanism of the invention. For example, FACCH could be used only if using it saves at least one second.
30   Because FACCH transfer is approximately 1.7 times faster than SDCCH transfer, it saves about 40% of the time needed by the SDCCH transfer. If it is required that at least one second must be saved, a minimum length for a USSD message would be 250 bytes. This exceeds the length of a single USSD message. In other words, performing the unsuccessful call attempt is
35   useful only with multiple consecutive USSD messages (assuming 83 and 140 bytes per second for SDCCH and FACCH, respectively, and a minimum sav-

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ing of one second). Of course, it must be remembered that initiating the unsuccessful call attempt wastes a fraction of a second. Thus the logic for initiating the unsuccessful call attempt should be placed at the top of the protocol stack, i.e. in the application layer. Otherwise the logic will not know that multi-
5 ple USSD messages are needed.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The method and the equipment according to the invention will be described in more detail by means of a preferred embodiment with reference to the appended drawing on which:
10 Fig. 1 is a signalling diagram illustrating mobile-originated USSD transfer; and

Figs. 2 and 3 are signalling diagrams illustrating network-originated USSD transfer.

DETAILED DESCRIPTION OF THE INVENTION
15 Fig. 1 is a signalling diagram illustrating mobile originated USSD transfer. Time advances from top to bottom. A USSD dialogue between two parties will be described. One of the parties is a mobile station MS and the other is a part or an element of a public land based mobile network PLMN serving that MS. The MS can be a small handportable cellular radio telephone
20 but the invention is best utilised if the mobile station comprises or is associated with data processing equipment. An example of such a mobile station is Nokia Communicator 9000. Another example is a general-purpose portable computer connected with a Nokia Cellular Datacard to a cellular radio telephone with a suitable interface, such as Nokia 2110 or 8110. All Nokia equip-
25 ment is available from Nokia Mobile Phones, Finland.

In step 1-2 a mobile station MS in idle mode determines that the length of the USSD transfer exceeds a predetermined threshold, which could be approximately 250 bytes. In step 1-4 the MS initiates a call attempt that ultimately should fail. One way of achieving this is calling a non-existent num-
30 ber. Alternatively, the MS could call itself. (At some later stage, the network PLMN will reply that the called subscriber does not answer, but this reply is not significant for understanding the invention.) Steps 1-6 through 1-12 constitute a mobile-originated USSD dialogue which is known per se. In step 1-6 the MS initiates the USSD dialogue by sending a BEGIN, INVOKE PROCESSUSSD-
35 REQUEST message to the network. (The primed message 1-4' will be explained

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later.) In step 1-8 the network responds with a CONTINUE, INVOKEUSSD-REQUEST message. In step 1-10 the MS sends a CONTINUE, RESULT USSDREQUEST message. The symbol "N*" indicates that the dialogue can comprise multiple pairs of messages 1-8 and 1-10. Finally, in step 1-12, the
5 USSD dialogue is terminated by an END, RESULT PROCESSUSSDREQUEST message from the network.

The primed message 1-4' relates to an alternative embodiment of the mobile-originated USSD transfer according to the invention, wherein the call attempt 1-4 is not performed before message 1-6 but only after it. In this
10 case, the call attempt is shown with reference number 1-4'. In other words, it is also possible for a mobile station to initiate the USSD dialogue in step 1-6 before performing the call attempt in step 1-4'. Thus steps 1-4' and 1-6 are not performed in numerical order.

The lower limit for activating the FACCH channel can be fixed, e.g.
15 approximately 250 bytes (which corresponds to a saving of one second over SDCCH). Alternatively, the lower limit can be an adjustable network parameter which the network distributes by some suitable means, such as broadcasting, short message service, multipoint transmission (in packet radio networks), etc.

Fig. 2 is a signalling diagram illustrating a simple embodiment of a
20 network-originated USSD transfer according to the invention. Messages with identical reference numbers to those in Fig. 1 have identical function and will not be described again. Step 2-2 corresponds to step 1-2 but in this case, the network determines that the mobile station MS is in idle mode and the length of the USSD transfer justifies the use of the faster FACCH channel (i.e. it ex-
25 ceeds a lower limit). In step 2-4 the network initiates a call attempt. However, unlike step 1-4 shown in Fig. 1, the network cannot call a non-existent number (obviously, because the MS would not be alerted). Instead, the network can send to the MS a PAGE message in step 2-4. Steps 2-6 through 2-12 constitute a network-originated USSD dialogue which is known per se. In step 2-6 the
30 network initiates the USSD dialogue by sending a BEGIN, INVOKE USSDREQUEST message to the MS. The primed message 2-4' relates to an alternative embodiment wherein the PAGE message is sent after the message 2-6, like the alternative setup message 1-4' in Fig. 1. Messages 1-8 and 1-10 have already been explained. In step 2-12, the USSD dialogue is terminated
35 by an END message.

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Fig. 3 is a signalling diagram illustrating a preferred embodiment of a network-originated USSD transfer according to the invention. The simple embodiment shown in Fig. 2 has the problem of confusing the user of the MS by the unsuccessful call attempt. The preferred embodiment shown in Fig. 3

5 eliminates this problem by converting a network-originated call attempt to a mobile originated one. In step 3-2 the network PLMN sends to the MS an indication that the MS must initiate a call setup procedure for activating the FACCH channel. This indication can be embedded, for example, inside a protocol-specific header or parameter in an appropriate WAP (Wireless Applica-

10 tion Protocol) layer. In the embodiment shown in Fig. 3, this indication has been embedded in the BEGIN, INVOKE USSDREQUEST message which was shown as step 2-6 in Fig. 2. In step 1-4 the MS initiates the unsuccessful call attempt by sending a SETUP message. The remainder of the procedure is similar to the one described in connection with Fig. 2.

15 The preferred embodiment of the network-originated USSD transfer has several advantages over the simple embodiment. For example, no special call setup routines are required in the network. Also, because the MS does not have to be paged, call setup is faster and the user of the MS is not alerted.

The invention requires neither hardware changes nor changes to

20 existing GSM standards. The invention can be implemented as software routines in a mobile station and/or the Public Land based Mobile Network PLMN. In the mobile station, the software routine can be installed in the cellular telephone proper, or in the associated computer, if any. Installing the software routine in the associated computer, if applicable, is advantageous in the sense

25 that such software has a better chance of knowing or predicting the total number of USSD messages that will follow, and their combined length. Alternatively, the software routine according to the invention can be installed in the cellular telephone proper but the associated computer could give the software routine an indication that several USSD messages are likely to follow and the

30 FACCH channel should be activated.

In the PLMN, the invention is preferably implemented in a more distributed manner. The logic for determining if multiple USSD messages will be needed must be placed near the actual application. Typical network elements for executing OTA and VAS applications include Mobile services Switching

35 Centres, USSD centres, Home Location Registers and Visitor Location Registers of cellular communications systems and Service Control Points of intelli-

gent networks. The logic for performing the unsuccessful call attempt, as de-
scribed in connection with Figs. 2 and 3, is preferably installed in a Mobile
services Switching Centre. Other possible locations include a BTS (Base
Transceiver Station), a BSC (Base Station Controller), and/or an RNC (Radio

5   Network Controller).

The invention has been described, by way of example, in connec-
tion with the GSM cellular system (Global System for Mobile Communication).
The invention is equally applicable in connection with the derivatives of GSM,
such as DCS (also known as GSM 1800), and any digital mobile communica-

10 tions network supporting USSD transfer on a fast channel if a mobile station is
in a call, and otherwise on a slow channel.